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EUROPEAN DATA FOR BUILDING RELATED POLLUTION LOAD AND BUILDING RELATED REQUIRED VENTILATION

Pawel Wargocki and P. Ole Fanger
International Centre for Indoor Environment and Energy
Technical University of Denmark

The pollution load from the building has been investigated in practice in four studies in Europe covering schools, kindergartens and offices. The studies cover more than 80 buildings in 9 countries.

In three of these studies (Fanger et al., 1988; Thorstensen et al., 1990; Pejtersen et al., 1991), buildings were visited while unoccupied during a weekend with the mechanical ventilation system in normal operation. A panel of 54 persons judged the acceptability of the room air just after entering the offices (Fanger et al., 1988) following the procedure specified by Appendix C of ASHRAE 62 (1989), whereas a panel of 13-15 trained judges rated perceived air quality just after entering classrooms in schools (Thorstensen et al., 1990) and spaces in kindergartens (Pejtersen et al., 1991) according to procedure specified by Bluyssen et al. (1989). At the same time the outdoor ventilation rates in the spaces were measured by tracer gas methodology. Based on these measurements, the sensory pollution load from the building (including HVAC system) was calculated as the equivalent number of standard persons (olfs) which would cause the same % acceptance of the indoor air as the pollution caused by the actual unoccupied building. When pollution loads were calculated, trained panel judgements were converted to untrained panel ratings by the transfer function established by Wargocki and Fanger (1999). The determined pollution loads from the building are listed in Table 1.

The fourth study (Bluyssen et al., 1996) took place in 56 office buildings. Each building was visited once by a trained panel of 12-15 persons when the building was occupied and at the same time the outdoor supply rate was measured by tracer gas methodology. Trained panel judgements were converted to untrained panel ratings by the transfer function established by Wargocki and Fanger (1999). The total pollution load was calculated as above and the contribution from the building was found by subtracting the person-related contribution based on CO_2 measurements (Table 1).

Table 1. Sensory pollution loads (olf/m^{2}floor) in different types of European buildings

Building type	n	25-percentile	median	mean±sd
schools[1]	6	0.03	0.06	0.06±0.04
kindergartens[2]	15	0.07	0.10	0.13±0.09
offices[3]	18	0.12	0.32	0.40±0.35
offices[4]	49	0.07	0.18	0.28±0.34

[1] Thorstensen et al. (1990); [2] Pejtersen et al. (1991); [3] Fanger et al. (1988); [4] Bluyssen et al. (1996)

Table 1 shows considerable variation among the buildings. The mean values for offices are quite high – elevated by spaces where smoking was allowed. Note, that the 25% lowest polluting buildings had a pollution load less than approx. 0.1 olf/m^{2}floor and the median value

(50%) was around 0.2 olf/m^2floor for all buildings categories. This is the reason why CEN selected the value of 0.1 olf/m^2floor as the realistic target value for "low-polluting buildings" in CR 1752 "Ventilation for buildings. Design criteria for the indoor environment" (1998). Requirements for low-polluting buildings in terms of maximum emissions from materials, etc. are listed in Annex to CR 1752. Buildings which do not meet these criteria are in CR 1752 categorized as "non-low-polluting buildings" with a sensory pollution load of 0.2 olf/m^2floor (Table 2) which is close to the median of existing buildings.

Table 2. Sensory pollution loads from the building specified by CEN CR 1752 (1998). Listed is also the corresponding ventilation required to handle the building load and obtain 80% acceptability of the indoor air quality

Building type	sensory pollution load (olf/m^2floor)	required building-related ventilation (L/(s*m^2floor)
low-polluting building	0.1	0.7
non-low-polluting building	0.2	1.4

In addition to the load from the building, the European CR 1752 prescribes a load from the persons present in the buildings which translates into a person related ventilation rate to be added to the building related rate.

In CR 1752 there is a strong encouragement to design for low-polluting buildings and in many buildings in Northern Europe it is today common practice to systematically screen building materials to make sure that selected materials will qualify for a low-polluting building. A data base of more than 400 common building materials exists (Clausen et al., 1996). The background for this effort are also the results of a large number of field studies in Europe and North America (Sundell et al., 1994; Jaakkola and Miettinen, 1995; Bluyssen et al., 1996; Groes et al., 1996; Sieber et al., 1996; Pejtersen et al., 1999; Apte et al., 2000) showing high rates of dissatisfaction and complaints of SBS symptoms in many buildings although existing ventilation standards (including ASHRAE 62.1) were met. The consensus is that pollution sources from the building and the HVAC system are a major reason for these symptoms. It is fundamental for the image of HVAC engineers that the building (including HVAC system) is acknowledged as a potential pollution source and every effort is made to control and minimize this source.

Recent studies in two countries documented a significant positive effect on office productivity and SBS symptoms of decreasing building related pollution sources (Wargocki et al., 1999; Lagercrantz et al., 2000; Wargocki et al., 2000).

Conclusions

- It is essential to acknowledge the building as a source of pollution in line with the occupants.
- A reduction of the building-related source should be encouraged.

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